Using Maximal Isometric Force to Determine the Optimal Load for Measuring Dynamic Muscle Power

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Abstract

Maximal power output typically occurs when subjects perform ballistic exercises using loads of ~30% of one-repetition maximum (1-RM). However, performing 1-RM testing prior to power measurement requires considerable time, especially when testing involves multiple exercises. Maximal isometric force (MIF), which requires substantially less time to measure than 1-RM, might be an acceptable alternative for determining the optimal load for power testing. **PURPOSE:** To determine the optimal load based on MIF for maximizing dynamic power output during leg press and bench press exercises. **METHODS:** Twenty healthy volunteers (12 men and 8 women; mean ± SD age: 31 ± 6 y; subjects: body mass: 72 ± 15 kg) performed maximal isometric leg press and bench press movements, during which MIF was measured using force plates. Subsequently, subjects performed ballistic leg press and bench press exercises using loads corresponding to 20%, 30%, 40%, 50%, and 60% of MIF. Therefore, these loads were excluded from analysis. Analyses were used to determine pair-wise differences. The criterion for statistical significance was P < 0.05.

Methods

Experimental Design. Subjects performed isometric leg presses and bench presses, during which MIF was measured using force plates. Subsequently, subjects performed ballistic, concentric-only leg presses and bench presses using loads corresponding to 20%, 30%, 40%, 50%, and 60% of MIF. Therefore, these loads were excluded from analysis. Analyses were used to determine pair-wise differences. The criterion for statistical significance was P < 0.05.

Results

Maximal Isometric Force

MIF values are presented in Table 1. The optimal relative load for measuring peak power output (i.e., 30-40% MIF) is similar to that which is recommended when loading is based on 1-RM.

Table 1. Maximal isometric force values (mean ± SD).

<table>
<thead>
<tr>
<th>Load (% MIF)</th>
<th>Females (n = 8)</th>
<th>Males (n = 12)</th>
<th>Total (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>188 ± 50</td>
<td>326 ± 60</td>
<td>257 ± 55</td>
</tr>
<tr>
<td>30%</td>
<td>200 ± 55</td>
<td>340 ± 65</td>
<td>270 ± 60</td>
</tr>
<tr>
<td>40%</td>
<td>212 ± 57</td>
<td>364 ± 70</td>
<td>288 ± 63</td>
</tr>
<tr>
<td>50%</td>
<td>224 ± 59</td>
<td>380 ± 75</td>
<td>307 ± 67</td>
</tr>
<tr>
<td>60%</td>
<td>236 ± 62</td>
<td>396 ± 80</td>
<td>321 ± 70</td>
</tr>
</tbody>
</table>

Figures 1 and 2. Peak power output (mean ± SE) during ballistic leg presses using different loads based on a percentage of maximal isometric force (MIF). *c* denotes trend (P > 0.05) for difference in power output compared to 60% MIF load.

Conclusions

Maximal isometric force (MIF), which requires little time and is inherently safe to perform, can be used as an alternative strength measure for determining the optimal load for power testing.

The optimal relative load for measuring peak power output (i.e., 30-40% MIF) is similar to that which is recommended when loading is based on 1-RM (i.e., ~30-50% 1-RM).

References


Acknowledgements

This work was supported by the National Aeronautics and Space Administration.

We would like to thank Kirk English, Mark Leach, and Leah Stroud for invaluable assistance during data collection and an enthusiastic group of volunteers for participation in the study. Results of the present study do not constitute endorsement by ACSM.